

SPEECH

ON

BEAUFORT SEA AND MACKENZIE RIVER DELTA
ENVIRONMENTAL STUDIES

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BEAUFORT SEA AND MACKENZIE RIVER DELTA ENVIRONMENTAL STUDIES

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ABSTRACT

The Beaufort Sea Project is a group of environmental and ecological studies being carried out in the southern Beaufort Sea, in the general area defined by the historic extent of summer open water between the Alaska-Yukon border and Cape Parry. A description is given of the types of studies and their importance relative to offshore exploratory drilling programs. The studies complement those already carried out and those currently in process under the auspices of the Arctic Petroleum Operators Association and include studies of wildlife, fisheries, baseline pollutants, physical oceanography, climatology, sea ice, and oil spill detection and clean-up. The studies are to be completed by the end of 1975. The Project is unusual in that the studies were specified by the Department of the Environment and remain its responsibility while the major funding and considerable management input is being provided by the offshore permit holders.

Now some recent history: on July 31, 1971, our government in a Cabinet Decision granted "approval-in-principle" for offshore exploratory drilling in the Beaufort Sea. This form of

* 1971 Geological Survey of Canada estimate in DOE (1971) made up of 2.2 B.Bbls of oil and 93.2 Tcf of gas where 1000 of of gas is the energy equivalent of 1 Bbl.

INTRODUCTION

The human quest for energy is focussing exploration on offshore sedimentary formations including those in the south-eastern Beaufort Sea. These, along with the land area of the Mackenzie Delta have an estimated recoverable potential of 22 billion barrels of oil equivalent*(1973). The S.E. Beaufort Sea is unlike offshore oil-bearing areas elsewhere, being bound by pack ice for 9 months of the year, and is subject to intrusions of moving ice at any time. As a result, offshore exploratory drilling plans have justifiably aroused the concern of government which has not only the responsibility to ensure future energy supplies but to ensure that disruptions to the social fabric and the environment are minimized in the process.

It is axiomatic that the extraction of natural resources cannot be done without perturbing the thin biosphere of our planet in which we live. It is therefore important to be knowledgeable not only in the economic but the social and ecological dimensions of resource extraction so that planning can be conscionable as well as rational.

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* 1973 Geological Survey of Canada estimate in BOE (B.bbls) made up of 6.2 B.bbls of oil and 93.5 Tcf of gas where 6000 cf of gas is the energy equivalent of 1 bbl.

approval means that oil companies or consortia who can show that their exploratory drilling plans are well engineered can proceed with the construction of drill ships and offshore platforms. Before drilling is permitted, however, a "drilling authority" is required. The Cabinet decision contained two important riders: firstly, no offshore drilling authorities would be granted prior to the summer of 1975 (this was later changed to 1976 in a statement made by the Minister of Indian and Northern Affairs), and secondly, a "very strict" environmental assessment of the southeastern Beaufort Sea would be required.

THE BEAUFORT SEA PROJECT

In response, the Department of the Environment designed an environmental assessment program, consisting of 29 specific studies, with the cost identified at \$5,300,000. These studies are collectively called the Beaufort Sea Project. In January, 1974, Treasury Board approved the Project but no funds accompanied this approval, the contention being that the oil industry must provide substantial supporting funds. After some months of negotiation, industry agreed to support 21 of the 29 Beaufort Sea studies, to the sum of \$4,100,000. The balance of \$1,200,000 required to fund the remaining 8 studies was to be funded from within the Department of the Environment. The agreement under which the industry was to transfer funds to government was signed

on May 15, 1974. This historic agreement states that the government will coordinate the Beaufort Sea studies and maintain cost control. Provision is made for an industry Project Manager to monitor progress on behalf of the oil operators and to jointly reallocate funds between studies with the government Project Manager. Resolution of differences is the responsibility of a senior government committee. Target date for completion of the studies is December, 1975. The agreement sets a major precedent for the provision of industrial funding for future environmental impact studies specified by the Department of the Environment.

The 20 million acre lease area of the S.E. Beaufort Sea extends from the Alaskan-Yukon border in the west to Cape Bathurst in the east. (Figure 1). The leases extend northward beyond 71°N and some are in water depths in excess of 1000 metres. Most Beaufort Sea leaseholders are members of the Arctic Petroleum Operators' Association (APOA). The formation of the APOA was encouraged by the Department of Indian and Northern Affairs for jointly funding the research required for the special Arctic conditions under which drilling systems are expected to operate. APOA-funded research in the period 1970-73 cost the petroleum industry \$2,500,000 in the support of applications for "approval-in-principle". The 29 studies in the Beaufort Sea Project have

been designed to be complementary to the APOA research.

Objectives .

What are the objectives of the Beaufort Sea Project?

They are:

- to increase our knowledge of the southeast Beaufort Sea so that the Arctic Waters Oil and Gas Advisory Committee, and ultimately Cabinet, can rule on petroleum industry applications for offshore exploratory drilling;
- to define the seasonal and geographical sensitivities of the Beaufort Sea so that the impact of future drilling activities in the region will be minimized; and,
- to provide a design for a weather and sea-ice prediction system so that drill ships and platforms can do exploratory drilling with a minimum of hazard to their personnel and to the environment.

The Beaufort Sea Project is a "crash" catch-up program, which cannot by itself provide full and detailed information on this remote, hostile and ecologically sensitive region. What is important is to have clear statements on what is known by December, 1975. These statements will be based on knowledge accumulated through many years of arctic research, much of it by the Project scientists, and on new knowledge to be collected during the 1974

and 1975 field seasons.

Scope of the project

The scope of the project is defined by three main constraints: firstly, its concern is with the Southeastern Beaufort Sea. Secondly, it is to be completed by December, 1975. Thirdly, it is confined to the impact of the exploratory drilling phase of offshore oil operations. During this phase, a major threat to the environment is the oil-well blowout. Most drilling could be conducted from drill ships floating in the open water during the short summer season. A wild well is most probable at the end of the summer, at a time when a relief well cannot be drilled with the time remaining before the ice closes. Such a well could run for a year before being brought under control. It has been estimated that in the Deltaic formations encountered offshore, a blowout would likely produce 2,500 barrels (2,500 x 5.6 cu. ft.) per day of crude oil initially, dropping to 1,000 barrels per day after one month's time. Accompanying this oil would be 800 cu. ft. of gas per barrel of oil, resulting in a release of 325 million cu. ft. of gas in one year. Should such a blowout occur in lease acreage north of the fast-ice zone, the problems of detection, oil containment, removal and clean-up in the moving pack-ice in the dark and cold of an Arctic winter could prove to be enormously expensive, if not impossible.

On the positive side, improvements in drilling technology have been significant and the probability of a blowout is remote where properly trained and alert drilling teams are in control. However, as the number of exploratory holes increases, and as long as human error remains to plague us, a blowout at some future date is almost inevitable.

In the face of a blowout risk, the Beaufort Sea studies have been designed to answer the following questions:

- What can be damaged in the environment of the Beaufort Sea? Examples are fisheries, marine mammals, birds which depend on the sea, and possibly the world's climate.
- How are pollutants transported and to where? Important mechanisms about which we know little include the ocean currents, sea-ice movements and storm surges.
- If damage does occur, how can changes be identified? For example, the detection of change in a living system requires knowledge of the system prior to the commencement of offshore drilling.
- How can exploratory drilling occur with minimum damage to the environment? We need to make knowledgeable choices of time of year and location where drilling will be permitted.

- What threats does the environment pose to the safety of offshore drilling? The critical factor here is the validity of the engineering data used for the design of drilling systems.

Scientists of the Arctic Biological Station, near Montreal, the Freshwater Institute in Winnipeg and the Fisheries Operations group in Vancouver are studying fish and marine-mammal populations and marine ecosystems. The Canadian Wildlife Service in Alberta is studying seabird, seals and polar-bear populations. Physical and chemical oceanographic studies and sea-ice problems which involve the inclusion of crude oil in sea ice, are being undertaken by the Pacific Region of Ocean and Aquatic Affairs in Victoria. Oil detection, containment and clean-up studies are the responsibility of the Environmental Protection Service in Burlington.

Other work includes marine geophysical studies by the Geological Survey of Canada in Ottawa and by the Bedford Institute in Dartmouth; sea-ice thickness distributions and measurements by the Inland Waters Directorate in Ottawa, meteorological studies by the Atmospheric Environment Service in Toronto, ice climatology studies by Ice Central in Ottawa, and Mackenzie River flow studies by the Inland Waters Directorate in Regina.

Figure 2 illustrates the importance of the Mackenzie River flow studies to an understanding of Beaufort Sea oceanography. This figure shows an ERTS[†] image of the Mackenzie River outflow into the Beaufort Sea on July 26, 1973. The turbid river waters contrast with the clear waters further offshore.

None of the studies referred to are directly related to the engineering integrity of offshore platforms or equipment. Rather, the concern of the Department of the Environment is with the effect of the intrusion of drilling operations on the environment, and with whether or not the environmental data used by the systems and structural engineers in the design of offshore drill ships and platforms is valid.

Oil and ice in the Arctic Ocean

While the scope of the Beaufort Sea Project is limited to the exploratory drilling phase, the scientific results can be applied to the production phase, with perhaps further studies of specific sites undertaken in the future. The assumption has to be made at this time that there will be a step-by-step learning process in development by the petroleum industry - from exploratory drilling under environmental constraints, to production and marketing, again under environmental constraints. One can visualize a grey scale of environmental concern caused by oil

[†]Earth Resources Technology Satellite

development in the Beaufort Sea. If "black" can be equated to "catastrophe", and "white" to no oil development at all, then the question is where do we position ourselves on this scale? In the extreme, if a single blowout in some lease areas can result in a catastrophic event, then the answer must remain "white": that is, there must not be drilling in those lease areas.

The visualization of large quantities of crude oil spilled into the Beaufort Sea has aroused world wide concern for the possibility of producing a catastrophic change in world climate. This concern is displayed in two recent articles: "Oil and Ice in the Arctic Ocean: Possible Large Scale Interactions" by W. J. Campbell and S. Martin (1973) and "Oil on Ice" by R.O. Ramseier (1974). These, in turn, have produced a rebuttal: "Oil Spills in the Arctic Ocean: Extent of Spreading and Possibility of Large Scale Thermal Effects" by R.C. Ayers, Jr., H.O. Jahns and J.L. Glaeser (1974). Although these articles are based almost entirely on speculation, they do point out the necessity for field data on the fate of oil entrained under sea ice, and for more definitive studies on its destiny in the circulating ice of the Beaufort Sea gyre and the Arctic Ocean. If large quantities of oil were to be swept up under ice and in open leads, all of it would end up at the surface after a few years. The oil would enhance the decay of the sea ice by

reducing its solar reflectivity, in turn, this could result in more open water than usual, which also has a lower reflectivity. If large areas were affected, the ice cover could irreversibly disappear, resulting in a serious alteration in the world's climate, perhaps even a new Ice Age.

Oil-in-ice studies

One specific study entitled "Oil-in-Ice" is designed to reduce the speculation surrounding this serious question of the possible spread of oil from a blowout in the S.E. Beaufort Sea. The study includes several key components. The first is a field experiment where crude oil is floated under sea ice within containment booms at various stages of its growth. Here, detailed heat conductivity and solar reflectivity measurements will be made. The second concerns scenarios for underwater blowouts in the offshore lease areas of the Beaufort Sea. The third concerns sea-ice factors which can package, confine and disperse oil in the Beaufort Sea and the Arctic Ocean. A fourth component includes an examination of the year-to-year variations in the natural extent of open water in the Arctic Ocean. These are caused by variations in the world's climate and by other changes such as melting caused by river outflows and atmospheric dust on the ice in the Arctic Ocean. These natural changes will be compared with estimates of change which could be caused by oil entrainment. If the estimate of change in heat flow

caused by oil entrainment is several orders of magnitude less than the change in heat flow resulting from the natural year-to-year variations, then the threat to climate could be dismissed.

The main thrust of past APOA industry funded studies has been aimed at the "safe operation" concept of offshore drilling - that the best way to deal with a blowout is to make every effort to prevent it. As a result, oil clean-up contingency plans for blowouts under the sea ice are dismally inadequate. This is not to say that the crude must be cleaned up in all circumstances; our studies must assess what the threat would actually be if no action were to be taken. The objective of the oil clean-up studies is to determine the engineering feasibility and costs of clean-up. Is it possible to detect oil under ice and its extent? Are remote sensing techniques useful? What equipment can be used to pump the oil to the surface and how can it be deployed? How is the contained oil to be disposed of? What are the consequences of firing the blowout and will firing be effective in areas of moving ice? These and many more questions must be answered and related to an assessment of the threat of an oil blowout.

Progress to date

This spring much work was completed in preparation for the

brief but expected 2½ month open-water season. Two research vessels, the MV THETA and the submersible support vessel MV PANDORA, left Victoria for the Arctic in early July escorted by the icebreaker CAMSELL. Unusually high concentrations of polar ice have remained in the S.E. Beaufort Sea this summer, in an area which historically exhibits large expanses of open water. (Figure 3). As a result, the ships arrived at Herschel Island three weeks late, on August 9th.

THETA supported oceanographic, fisheries and biological studies, while PANDORA was used to support offshore marine geophysical studies. However, the effects on the Project of a shortened and ice-plagued ships' program have yet to be gauged. Earlier in the spring, 9 tide gauges and 10 current meters were laid between Herschel Island and Baillie Island to water depths of 200 metres. The plan was to recover these gauges and lay them again using MV THETA during the summer. Plans also included extensive use of the submersible PISCES to examine sea-bottom scours caused by pressure ridge keels.

Arctic research has always been extremely expensive and never more so than this year. The pace of industrial activity is increasing at a rate which is rapidly surpassing the resources of the Department of the Environment in being able to anticipate and scrutinize the impact of these activities. Large fractions

of future environmental assessments must be done under contract and with funds provided by industry, that is, the proponent must pay. At the same time, government has the responsibility for controlling the impact of northern industrial activity, hence direct participation by government scientists must be extensive. This is the way the Beaufort Sea Project operates and we'll see more projects of this kind in the future.

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Figure 1: The 20 million acre lease area of the Beaufort Sea

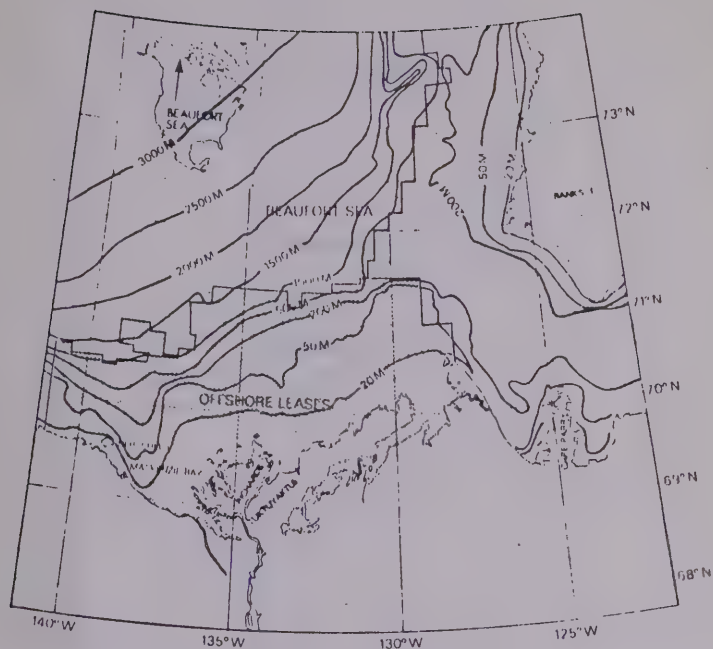


Figure 2: An ERTS image of the Mackenzie River outflow into the Beaufort Sea for 26 July, 1973.

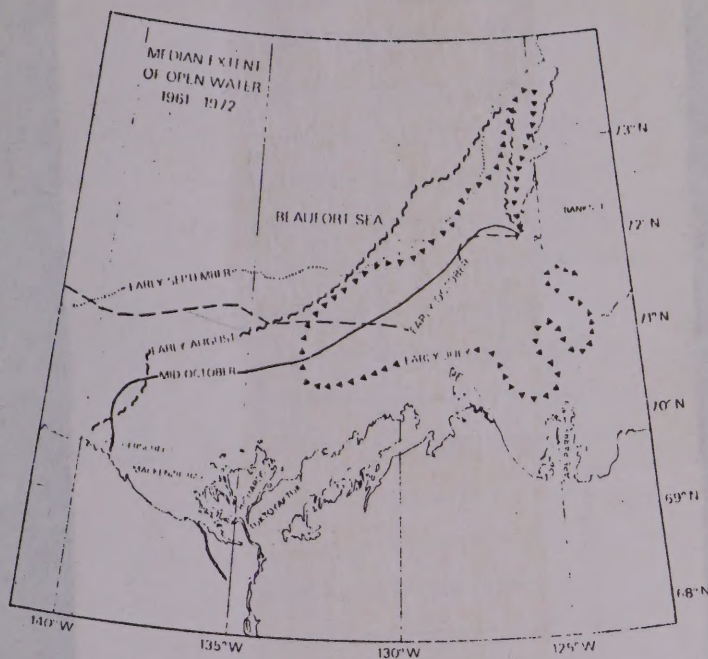


Figure 3: Boundaries defining the median extent of open water in the Beaufort Sea for the years 1961 to 1972.

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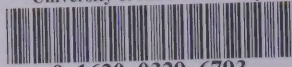
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Figure 3: Boundaries defined the median extent of open water
in the Beaufort Sea for the years 1981 to 1975

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